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Why research integrity matters and how it can be improved

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ABSTRACT

Scholars need to be able to trust each other, because otherwise they cannot collaborate and use each other's findings. Similarly trust is essential for research to be applied for individuals, society or the natural environment. The trustworthiness is threatened when researchers engage in questionable research practices or worse. By adopting open science practices, research becomes transparent and accountable. Only then it is possible to verify whether trust in research findings is justified. The magnitude of the issue is substantial with a prevalence of four percent for both fabrication and falsification, and more than 50% for questionable research practices. This implies that researchers regularly engage in behaviors that harm the validity and trustworthiness of their work. What is good for the quality and reliability of research is not always good for a scholarly career. Navigating this dilemma depends on how virtuous the researcher at issue is, but also on the local research climate and the perverse incentives in the way the research system functions. Research institutes, funding agencies and scholarly journals can do a lot to foster research integrity, first and foremost by improving the quality of peer review and reforming researcher assessment.

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Research integrity; questionable research practices; open science; validity; trustworthiness

Scholars need to be able to trust each other, because otherwise they cannot collaborate and use each other's findings (de Ridder, 2022; Bouter and ter Riet, 2021). Similarly trust is essential for research to be applied for individuals, society or the natural environment. The trustworthiness is threatened when researchers don't do their utmost best to get it right and engage in questionable research practices or worse. By adopting open science practices, research becomes transparent and accountable. Only then it is possible to verify whether trust in research findings is justified (Peels and Bouter, 2021). The magnitude of the issue is substantial with a prevalence of four percent for both fabrication and falsification, and more than 50% for questionable

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research practices (Gopalakrishna et al., 2022). This implies that researchers regularly engage in behaviors that harm the validity and trustworthiness of their work. What is good for the quality and reliability of research is not always good for a scholarly career. Navigating this dilemma depends on how virtuous the researcher at issue is, but also on the local research climate and the perverse incentives in the way the research system functions. Research institutes, funding agencies and scholarly journals can do a lot to foster research integrity, first and foremost by improving the quality of peer review and reforming researcher assessment.

Breaches of research integrity are traditionally labeled as one of the classical forms of research misconduct: fabrication, falsification and plagiarism (Figure 1). Dramatic cases of research misconduct often serve as wake-up calls. It's clear that research misconduct seriously harms the validity and trustworthiness of research (Bouter, Kleinert and Horn, 2021). However, a lack of research integrity can also consist of minor misbehaviors. These are rather euphemistically labeled as questionable research practices (QRPs). Examples are selective reporting, p-hacking and HARK-ing – which means hypothesizing after the results of a study are known. Recent revisions of codes of conduct for research integrity increasingly acknowledge that research misconduct and QRPs for a continuum (e.g., Bouter 2023).

One of the biggest academic disillusions of the last decade is that when studies are repeated, on average their findings will only be the same in half of the instances (Cobey et al. 2022). This is known as the "replication crisis." Gradually the causes of this crisis have become clear, and they have been found to overlap with what research integrity scholars have labeled as QRPs. The last decade has also brought us the wonderful innovations of open science (Nosek et al. 2018). In particular, open methods, open codes and open data arguably increase the transparency and accountability of research (Haven et al. 2022). These and other responsible research practices will help

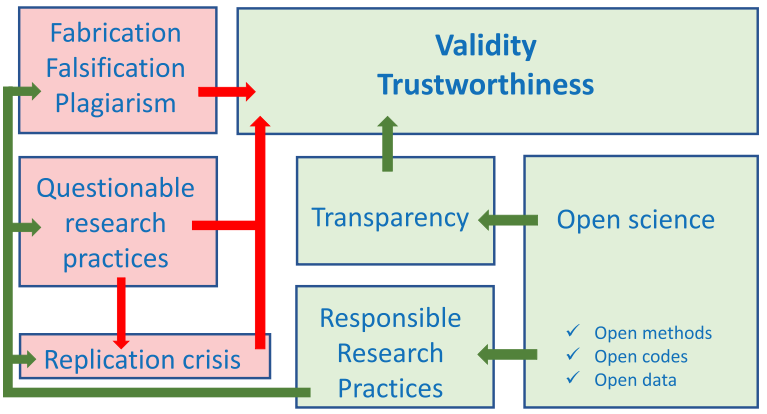

Figure 1. How research integrity and open science hang together.

to solve the replication crisis, decrease the occurrence of QRPs, and maybe even of research misconduct as well (Figure 1). The ultimate consequence of this is that both the validity and trustworthiness of research will increase when open science practices are implemented on a large scale.

Prevalence of research misbehaviors

In the Dutch National Survey on Research Integrity 11 QRPs were assessed on a seven-point scale, ranging from never to always and referring to the last three years (Gopalakrishna et al. 2022). The prevalence figures we calculated refer to respondents who scored five, six or seven on that scale. Selective reporting and poor supervision, as well as giving insufficient attention to study flaws, equipment and taking notes on the research process, all have a self-reported prevalence between 15% and 18%. More than half of the respondents reported having engaged frequently in at least one of the 11 QRPs included in the survey. This makes it clear that QRPs are indeed alarmingly common. Maybe even more shocking is that more than four percent admitted to having engaged in data fabrication at least once during the last three years. Furthermore, also more than four percent confessed to having engaged in data falsification. Our findings are in line with the range of other surveys (Fanelli and Tregenza 2009; Xie, Wang, and Kong 2021). To put it mildly: there seems to be plenty of room for improvement.

Research can either support or reject its core hypothesis. This is usually talked about in terms of positive or negative findings. Positive findings are easier to get published in prestigious journals, are cited more often, and also gain more media attention. This probably increases the likelihood of obtaining grants and tenure. QRPs, fabrication and falsification are effective tools for obtaining positive findings, which is of course undesirable because these positive findings would be false. Negative findings are so unpopular that they are often not reported at all. It has been shown for many research fields that only about five percent of the published articles concern negative studies (e.g., Scheel, Schijen, and Lakens 2021). This selective reporting leads to a strong dominance of positive findings in scholarly literature, which is the root cause of the replication crisis. If we want to prevent bias due to selective reporting of the findings of valid hypothesis testing studies, these findings should always be made available in a suitable form.

To prevent QRPs and worse, we should be strict with ourselves and our colleagues. We need to trust each other, but also to be able to verify whether that trust is justified. Being virtuous is of course important, and research integrity education is often designed to develop that attitude (Labib et al. 2022; Inguaggiato et al. 2023). The behavior of individual researchers is also strongly shaped by external influences. The research climate in a particular lab or department can strongly influence research integrity. When for

instance demands are unreasonable, competition is fierce and tenure decisions are unfair, research integrity may suffer. The same is true for the – sometimes perverse – incentives within the academic system, like having an almost exclusive focus on numbers of publications and citations. This comes with a personal responsibility: individual researchers must do everything they can to improve the research climate and to remove perverse incentives. In addition to this they should reflect on their own behavior and ask themselves for instance whether their work is influenced by other interests than finding the truth and whether they have the skills, equipment and expertise needed. Early career researchers in particular are often leading the efforts to change research culture and practice (Kent et al. 2022). When research institutes, scholarly journals and funding agencies adopt open science practices, research becomes transparent and accountable (Bouter 2020; Macleod 2022).

Drivers of research misbehaviors

In the National Survey, we also studied drivers of research integrity (Gopalakrishna et al. 2022, 2022). We found that a stronger belief in the ability of reviewers to detect fabrication or falsification was associated with a lower prevalence. Respondents who reported the strongest support for the research integrity standards were less inclined to engage in QRPs and fabrication or falsification. They also reported more responsible research practices. Our findings support the idea that there are two forms of supervision. Supervision for survival consists of guidance on how to use QRPs with a view to obtaining positive results and advancing your career as an academic scholar. As might be expected, this is associated with a higher prevalence of QRPs. Responsible mentoring, on the other hand, helps the mentee do the right things. This is associated with less engagement in QRPs and more engagement in responsible research practices. A higher score for perceived publication pressure is associated with a higher prevalence of QRPs and a lower prevalence of responsible research practices.

What can research institutes do?

The EU-funded Standard Operation Procedures for Research Integrity (SOPs4RI) consortium outlined nine topics which research institutes need to act upon to foster research integrity (Mejlgaard et al. 2020). Policies to improve research integrity must be co-created locally (Labib et al. 2022). Researchers and support staff need to be involved in analyzing the problem, as well as in designing and implementing its solutions. On its website (https://sops4ri.eu/), the SOPs4RI consortium has a toolbox that contains 121 guidelines to inform and inspire institutional research integrity policies.

Careers in research are determined by assessments for grants, promotion and tenure. Often the focus is on the number of publications and citations, including the Impact Factor and the Hirsch Index. In recent years, the San Francisco Declaration (Raff 2013), the Leiden Manifesto (Hicks et al. 2015) and the Hong Kong Principles (Moher et al. 2020) have been launched: all three initiatives urge for the use of better assessment criteria – the first and most important being engagement in open science practices. Other behaviors that should be valued are being a good reviewer, a good supervisor, a good teacher, a constructive team member and an effective communicator. Currently a wealth of initiatives explore ways to improve researcher assessment (Aubert Bonn and Bouter 2021; Editorial 2022; Neylon 2022). Research institutes increasingly engage in reforms of researcher assessment, partly inspired by the nine guidelines on that topic included in the SOPs4RI toolbox.

Research institutes can govern research integrity in three ways: through markets, hierarchies or networks. Markets rely on incentives and competition. When out of balance, this leads to perverse incentives, to a high perceived publication pressure and to hypercompetition. Hierarchies are based on rules and bureaucracy. The potential downsides are a "tick-box" mentality and low levels of perceived organizational justice. Governing through networks entails mutual trust and cooperation. The downside of this approach is that consensus might not be reached and adequate actions will be postponed. A carefully designed combination of these three modes of governance likely works best (Labib et al. 2022). In essence, adequate rules and incentives are indispensable, but should be supported by the institutional network of researchers. Only then can bureaucracy and competition be limited to areas that really optimize research integrity.

What can funding agencies do?

All scholars need funding for their research. Funding agencies can change practices quickly, as some did when they made open data and open access publication mandatory. Obviously, the way funding applications are assessed and decisions about awarding grants are made contain many research integrity pitfalls. Identifying and handling potential conflicts of interest among reviewers and committee members is one of them. The SOPs4RI consortium recommends that funding agencies should also develop a research integrity promotion plan (Horbach et al. 2022). For funding agencies there is a toolbox available on the SOPs4RI website (https://sops4ri.eu/), which currently contains 29 guidelines.

Competition for research funding is fierce. Often less than 10%, and sometimes even less than 5%, of the applications can be granted. Many applications that deserve to be granted have to be rejected for budgetary

reasons. There is convincing evidence that committees are not able to rank eligible applications reliably (Horbach, Tijdink, and Bouter 2022a). The difference between success and failure is often less than 0.1 – and sometimes less than 0.01 – on a five-point scale. This suggests a role for lottery in the allocation of research grants (Horbach, Tijdink, and Bouter 2022a; Heyard et al. 2022). The idea is simple: once the applications which are not good enough to be granted have been weeded out, a lottery is held to decide which proposals will be financed. This may be less demotivating for applicants and it's likely that lottery would make grant allocation fairer, more efficient and more diverse.

It can be argued that funding agencies need to adopt transparency in their own work too, and should openly share applications, review reports, funding decisions and evaluations of the execution of granted projects (Horbach, Tijdink, and Bouter 2022b). A transparent grant allocation process will likely improve the quality of review reports and granting decisions. Open applications also enable research on funding practices and will lead to greater trust in the funding allocation process.

What can journals do?

Scholarly journals also have a role to play in fostering research integrity. Journals are the guardians of the validity and trustworthiness of the published body of knowledge. Journals can also influence earlier phases of a study by demanding open methods and open data. We investigated whether journals' instructions to authors mention items that improve transparency (Malički et al. 2019, 2021). Of the 19 items studied, only two were mentioned by more than half of the journals, while five were discussed by less than 10%. A number of these items feature in the Transparency and Openness Promotion Guidelines, which are currently adopted by over 5000 scholarly journals (Nosek, et al., 2015).

Journals have also other ways of fostering research integrity. Open peer review is one of them. Reviewing is an important duty for scholars and one for which they deserve credit, but at the same time they need to be accountable. Review reports are part of a scholarly debate, and should be openly accessible to all interested parties. Open peer review is likely to be more balanced and fairer as well. Editorial offices should screen manuscripts for plagiarism, image manipulation, statistical errors and references to retracted publications. Adequate software is increasingly becoming available for these checks (Schulz et al. 2022). Journals also ought to retract rapidly when this is indicated. Sadly, journals have a poor track record on retraction. If it happens at all, it is often years after the initial concerns were raised (Oransky 2022).

An exciting innovation is the introduction of registered reports (Chambers 2019). The idea is simple: when the grant has been awarded and the study is

about to start, you first write the introduction and methods sections of the envisioned later publication. These are submitted and sent out for peer review. The reviewers and the editor will then judge the relevance and methodological soundness of the study. The point is that they will not be distracted by the findings, because the data collection has not even started. When the manuscript is accepted for publication, the only later check is whether the study was performed as described in the method section and whether the results are reported and discussed adequately. This publication format completely eliminates publication bias (Scheel, Schijen, and Lakens 2021). And there is an important bonus: in registered reports review comments can actually improve the design of the study, which is not the case for the standard work flow (Soderberg et al. 2021).

Final remarks

In this commentary I have argued why research integrity matters and how it can be fostered by a diverse range of stakeholders. While these views are based on the available evidence, it is worth noticing that little to no research has been carried out on a substantial number of the issues I discussed. Next to effective actions based on what we already know, we clearly need more research on research integrity (Tijdink et al. 2021). Some funding agencies have made grants available, but the job is by no means finished and I sincerely hope that the current momentum can be maintained and that, in years to come, research integrity policies will increasingly be based on a thorough and comprehensive body of research.

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